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RADAR RANGE CALIBRATOR SYSTEM EVALUATION REPORT. (U)
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RADAR RANGE CALIBRATOR
SYSTEM EVALUATION REPORT

Federal Electric Corporation
Vandenberg AFB, Calif. 93437

2 December 1976

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Prepared for

SPACE AND MISSILE TEST CENTER
Vandenberg AFB, Calif. 93437

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This final report was submitted by Federal Electric Corporation, Vandenberg AFB, CA 93437 under Contract FO 4701-72-C-0203 with the Space and Missile Test Center, Vandenberg AFB, CA 93437. Operations Research Analyst, Mr. R. Lane, XREA, was the Division Scientist-in-Charge.

This report has been reviewed by the Information Office (OI) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The Radar Range Calibrator System was installed at the Pillar Point AN/FPQ-6 radar during September 1976. The system is capable of generating a target at a known range using digital techniques. An evaluation of this system is presented in this report.			

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4.0 SYSTEM LEVEL TESTS

Radar data from GEOS III tracking missions were used to evaluate the RRCS from the system level, i.e., does the RRCS accurately calibrate the range measurements of the radar? Table I provides the results of this testing.

Table I
System Level Test Results
AN/FPQ-6

Date	GEOS III Rev No	Range Bias (Ft)
24 Aug 76	7114	-5
25 Aug 76	7128	Bad site tape
27 Aug 76	7157	9
1 Sep 76	7228	16
3 Sep 76	7242	-4
10 Sep 76	7356	16
11 Sep 76	7441	Bad site tape
20 Sep 76	7498	-3
30 Sep 76	7626	1
14 Oct 76	7825	<u>-9</u>
	Mean (Ft)	2.6
	Std. Dev. (Ft)	10

These biases are defined as the radar measurement minus the NSWC reference orbit and are indicative of excellent range zero set capability. The accuracy of the NSWC ephemerides used for the reference standard are not known other than NSWC quotes of 5 meters or better. A test to test variability in the reference data of up to 10 feet at the one sigma level is not unreasonable.

5.0 DETAIL LEVEL TESTS

The following tests were performed on site by Performance Analysis during October for purposes of establishing the RRCS baseline capabilities:

- a. Stability of range calibration lock-on as a function of signal level.

FPQ-6 Radar Range Calibrator System

1.0 INTRODUCTION

In August of 1976 the Radar Range Calibrator System (RRCS) was installed at the FPQ-6 under Engineering Task CET-ER-606. The evaluation of the RRCS was conducted in two phases: testing and evaluation conducted by the Instrumentation Systems Engineering Department (IC400) and testing and evaluation conducted by the Performance Analysis Department (PA300). This report documents the evaluation conducted by the Performance Analysis Department and is intended to define, both the baseline accuracy of the RRCS and its operational usage.

Results of the evaluation show that except for minor discrepancies, the calibrator is accurate and it is recommended that it be used during operational support.

2.0 RANGE CALIBRATION MODIFICATION

The range calibration modification at the FPQ-6 was installed to provide the radar system with a calibration method which would minimize the errors which occur in the range measurements due to pulse width mismatch conditions and due to pulse shape distortion caused by clutter and multipaths using an external range target. Basically the pulse width mismatch error occurs when the radar pulse width and corresponding return from the range target is not equal to the pulse width of the signal return from the C band transponders carried aboard ballistic missiles launched from Vandenberg Air Force Base. The form of the error and the model for correction are reported in Range Bias Corrections, report number PA100-75-40, 3 August 1976 and will not be covered in this report.

3.0 EVALUATION APPROACH

Two levels of testing and evaluation were conducted by the Performance Analysis Department. The first consisted of system level tests conducted in association with GEOS III tracking missions and the second a series of tests conducted on site specifically designed to detect potential error sources and define the capabilities of the modification.

- b. Linearity of the range calibrator.
- c. Width, stability and rise-fall time of output pulse.
- d. Ability to lock-on radar beacons at a known range after calibrating on the RRCS.

5.1 OUTPUT PULSE EVALUATION

The RRCS output pulse was evaluated with the use of a Hewlett-Packard 7844 (7824/7B80/7B85 plug-ins) oscilloscope. The 30 MHz output (J-4) was displayed as shown in Photo #1 (Figure 1). In this photograph the pulse is displayed on three traces. The sweep speed on the top trace is 200 nanoseconds per centimeter. The entire pulse appears again on the second and third traces at a sweep rate of 50 nanoseconds per centimeter. The trigger time on the second and third traces have been adjusted so that the leading edge of the pulse on the second trace just coincides with the trailing edge of pulse on the third trace. The difference in trigger time is presented digitally as $\Delta 0.136 \mu\text{sec}$ at the bottom on the oscilloscope. This feature permits a high degree of resolution for measurement of pulse widths.

5.1.1 RISE TIME

The rise and decay time of the output pulse was observed to be very fast. Something less than five nanoseconds may be observed in the photograph.

5.1.2 WIDTH STABILITY

Pulse width stability appears good. Instability was not observed at a measurable level.

5.1.3 PULSE WIDTH BIAS

The width of output pulse shown in photo #2 is the minimum width available and was measured as 126 nanoseconds. Initially the bias was believed to be 136 nanoseconds as shown in photo #1. It was later determined that the 12 nanosecond switch operates in reverse if the "Range" switch is in the "up" position (as it was during the test). Photo #1 was taken with the 12 nanosecond switch in the "off" position while the range switch is "up". Photo

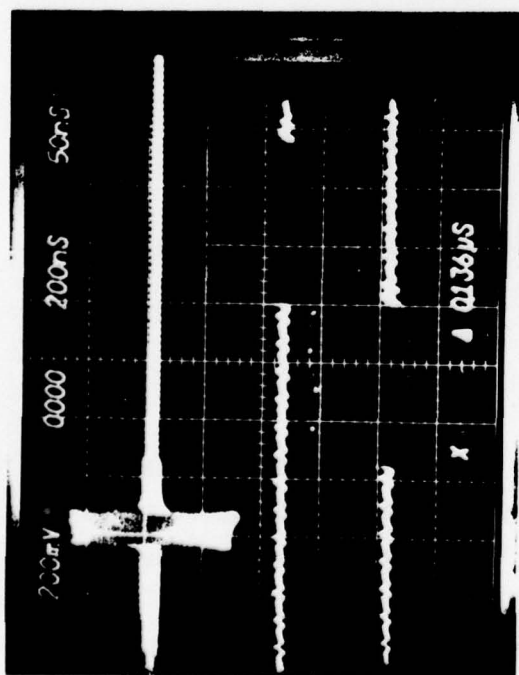


PHOTO 1

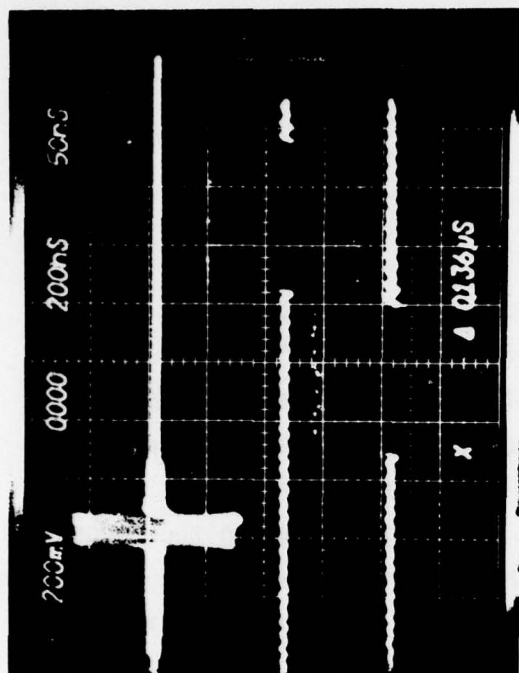


PHOTO 3

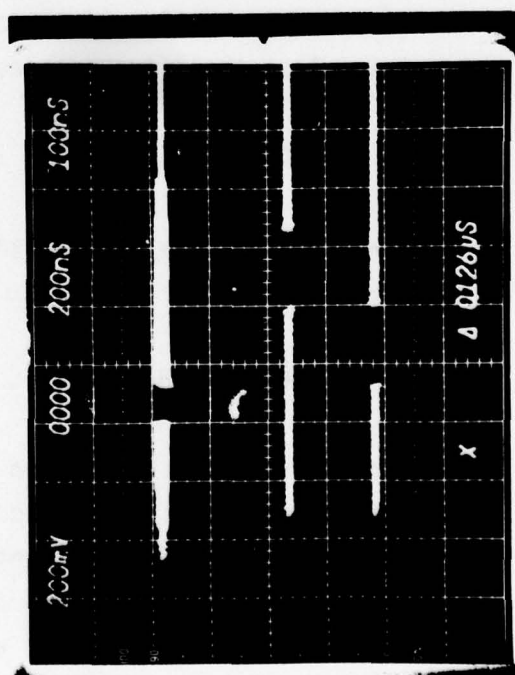


PHOTO 2

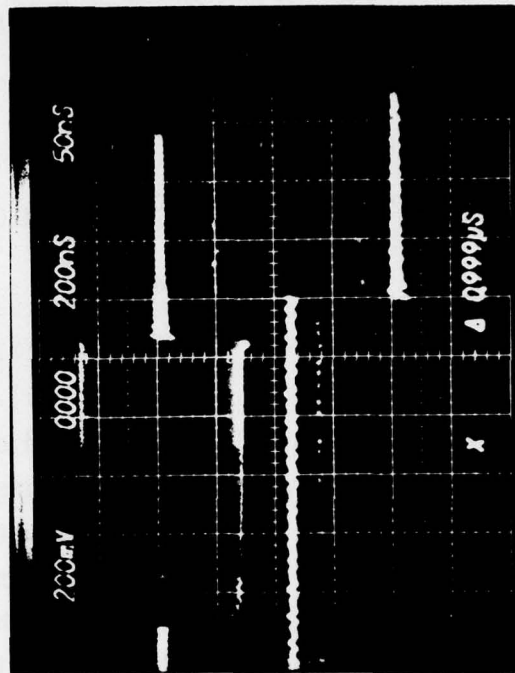


PHOTO 4

FIGURE 1

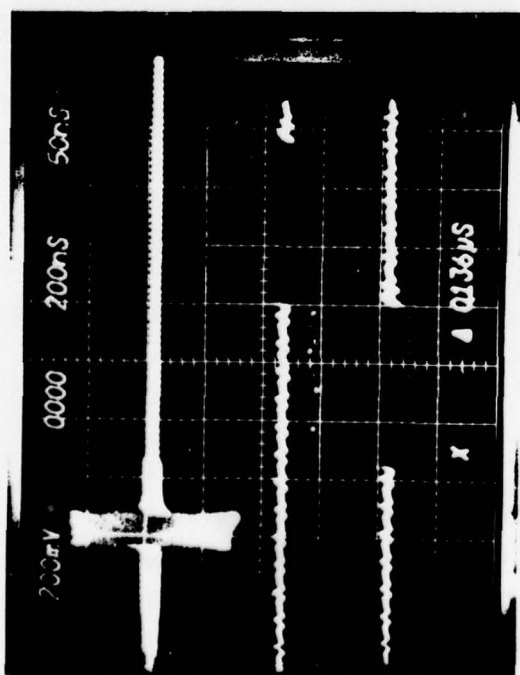


PHOTO 1

PHOTO 2

FIGURE 1

PHOTO 3

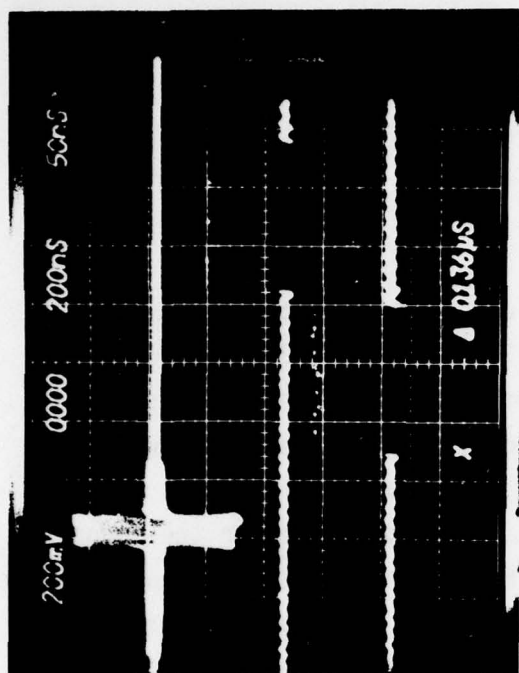
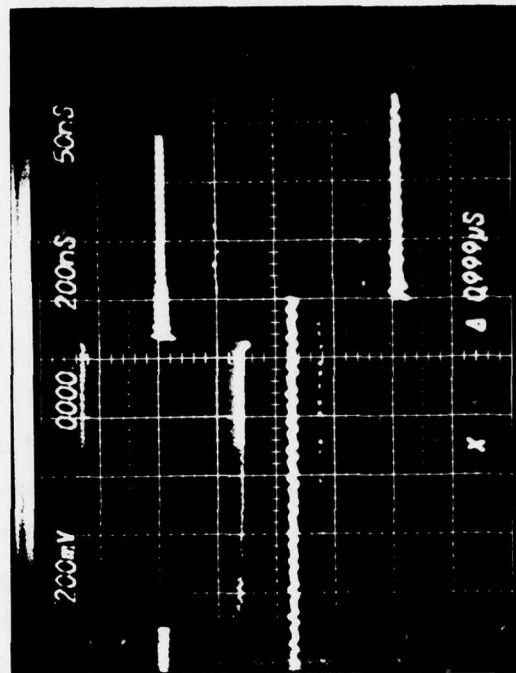
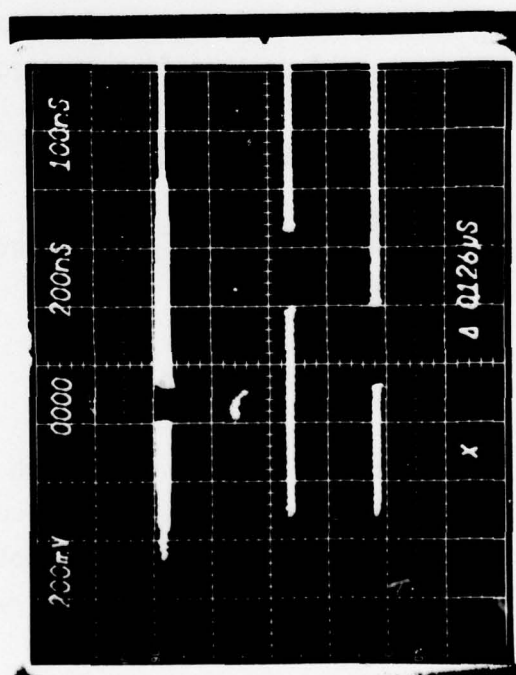


PHOTO 4



#3 shows the result of moving the range switch down while the 12 nanosecond switch is unchanged. The leading edge of the pulse has shifted 12 nanoseconds in photo #3, as it should, but the width has also changed. When the range switch is in the "down" position the operation of the 12 nanosecond switch is proper.

The initial calibration of the RRCS was accomplished with the range switch in the "up" position. Therefore, the 12 nanosecond switch was labelled "reversed" on the front panel to correct the problem. This will present no problems in the operation of the unit until such time that a permanent correction can be made.

5.1.4 PULSE WIDTH ACCURACY

All pulse width switches were operated independently and the width of each pulse was measured and recorded on the data sheet (Appendix A). After subtracting the bias of 126 nanoseconds from the measured widths the mean of the differences (measured change minus expected change) is zero indicating that the 126 nanosecond bias is valid. The standard deviation is 3.2 nanoseconds. A 3 nanosecond error in pulse width calibration represents an error of 0.75 ft in range which is insignificant.

Switches were used in combinations to generate pulse widths of .25, .5, .75 and 1.0 μ seconds. The 1 μ sec pulse is shown in photo 4.

5.2 LINEARITY OF PULSE POSITIONS

The RRCS pulse (range) position switches were set to the 100 k yd position. The pulse was gated at the radar and placed in auto track mode. The radar console display indicated 100,000 yds with occasional indications of 99,999 yds (1 yd low). The RCM was switched to provide a pulse at range of 200 k, 300 k, ... 1,000 k yds. The radar always read the correct range when locked on the target. Lock-ons were also made at 25 k and 50 k with the same result. Linearity was excellent as expected (see data sheet Appendix A).

5.3 STABILITY OF RANGE LOCK-ON AS A FUNCTION OF SIGNAL LEVEL

An RF attenuator was placed between the Watkins/Johnson mixer and the 40 db directional coupler (10 A6A24) located in the RF head. The radar was locked

on the RRCS output at a range of 100 k yds. The console display indicated 100,001 yds, occasionally reading 100,003 yds with no attenuation. Attenuation was inserted in steps of 5 db.

AGC voltage and console range display readings were recorded on the data sheet (Appendix A). The radar range was observed not to change over a 50 db attenuation range. The AGC voltage which should have continued to change until the noise level was reached did not decrease beyond the 30 db level (well above the noise floor). Since the attenuation did not effect the signal beyond 30 db, leakage was suspected. It was determined that the signal was present at the receiver even when the input to the attenuator was disconnected.

The RF leakage problem did not appear to produce adverse effects when the range calibration system is being used. The Instrumentation Systems Engineering Department is aware of this problem and has provided new cabling.

5.4 RADAR BEACON TESTING

The USAF Geodetic Survey Squadron was asked to determine the range between the radar pedestal and a selected position on Montara Peak. Two C band beacons were operated at the surveyed position while the radar tracked and recorded range data. The radar was calibrated using the RRCS and the pre operation parameters for each beacon as shown in Table II.

Lock-on values for both beacons are tabulated below.

	Radar Lock-on (yds)	Corrected Lock-on (yds)	Beacon Survey (yds)	Corrected Lock-on minus Survey (yds)
174C	8040.8	8045.5	8043.3	+2.2
302C	8045.4	8054.4	8043.3	+11.1

Corrections were made (see Appendix A) for beacon delay errors, cable delay between beacon and antenna, and pulse width errors. Pulse width set at the radar was based on preoperation beacon tests. Corrections were based on the mean of pre and postoperational beacon test data.

Table II
AN/FPQ-6
Pre Operation Measurements
Beacon Parameters
(SAMTEC Form 89 were completed (pre-and post test)
and are included in Appendix A)

	Motorola 174C (coho)	Vega 302C
Ser #	103	3150
Delay (-20 dbm)	2.501 μ sec	2.49 μ sec
PW	.927 μ sec	.535 μ sec
Real Time	.077 μ sec	.011 μ sec
Fall Time	.041 μ sec	.025 μ sec
Date	3 Aug 76	29 Sep 76

Post Operation Measurements

Delay (-20 dbm)	2.507 μ sec	2.47
PW	.983 μ sec	.535
Rise	.013 μ sec	.013
Fall	.020 μ sec	.051
Date	8 Nov 76	3 Nov 76

Actual beacon delay used at the radar was 2.573 μ sec (422 yds) on the 174C beacon and 2.561 μ sec (420 yds) on the 302C beacon.

6.0 GENERAL OBSERVATIONS

Site personnel stated that the RRCS caused interference, which is noticable on the range scope at the operators console, even though power to the RRCS is turned off. It can be eliminated by disconnecting the 30 MHz input to the RRCS. Interference of this nature was not observed during the evaluation period. Engineering (IC400) is aware of the problem and intends to investigate. It is recommended that the power be removed from the RRCS and the 30 MHz input be disconnected at the source when the system is not in use to preclude interference of this type.

7.0 OPERATIONAL TESTING

Data was recorded during support from Operations 8080, 6995 and 1160 for purposes of obtaining range data recordings at pulse widths used during Minuteman support. The radar range was zero set and the beacon delay adjusted using the range target and the radar transmitter. Data recordings were then made of the skin gate and beacon gate measurements while tracking the RRCS signal. Table III is a summary of the results obtained during those operations. As may be seen from the Table the data obtained from the RRCS agreed very well with theoretical values. All lock-on values for Operation 6995 were short by 14 yards with respect to the RRCS. Data for GEOS III operations previous and subsequent to Operation 6995 have been examined but no errors were detected. The cause for all RRCS values being short by 14 yards could not be isolated.

TABLE III
FPQ-6 RADAR RANGE CALIBRATOR SYSTEM
OPERATIONAL EVALUATION

OP NUMBER	TX PW μsec	BEACON PW μsec	BEACON DELAY		BEACON DELAY		B-A	
			FROM RANGE	TGT (Ft)	FROM RRCS (Ft)	MEAS (Ft)	THEOR (Ft)	
8080	1.0	0.89	1215		1239	24	27	
6995	1.0	0.90	1230		1260	30	25	
1160	1.0	0.86	1220		1255	35	34	

NOTE: Skin gate data from RRCS obtained at TX PW at 10 k yds.
Beacon gate data from RRCS obtained at beacon PW at 10 k yds.

APPENDIX A

INDICATOR		SST174C 103		STD		KF-ML		3170-10	
VEHICLE TYPE		FACILITY		WAFER S/N		BACK-UP		TEST DOCUMENT	
TEST SET P/N		TEST SET S/N		BEACON		BEACON		TOTAL TIME	
TSS		001		ON		OFF		4.75	
ANTENNA P/N		ANT. 1 S/N		ANT. 2 S/N		ANT. 3 S/N		COUPLER P/N	
COUPLER S/N		BATT. P/N		BATT. S/N		DATED			
TRANSMITTER					RECEIVER				
1. Time to See - Pwr Delay Timer					23. Receiver Bandwidth @ 3 dB				
< 30 Sec					Total 8.7 MHz				
2. Time to Stabilize					Low 5760.0 MHz				
90 Sec					Hi 5768.7 MHz				
3. Transmitter Frequency (+3 min)					24. Receiver Bandwidth @ 60 dB				
Start 5763.5 MHz					Total				
Finish 5763.5 MHz					MHz				
4. Frequency Drift Rate (MHz/min)					Low				
Start 0.233 MHz					Center				
Finish 0.0 MHz					Hi				
5. Pulse Frequency Jitter					25. Threshold Sensitivity				
N/A MHz					- 71 dBm				
6. Pulse Width					26. Dynamic Range				
@ 0.5 .927 μsec					Low -65 dBm				
@ .75 .928 μsec					Hi 0 dBm				
@ 1.0 .927 μsec					27. Image Rejection				
7. Pulse Width Jitter					- 34 dB				
.019 μsec					28. Pulse Width Acceptance				
8. Pulse Amplitude Variation					Low < 2 μsec				
< 1.0 dB					Hi > 3 μsec				
9. Pulse Amplitude Jitter					29. Decoder Accept Limits @ -55 dBm				
< 0.5 dB					Low 8.76 μsec				
10. Pulse Rise Time					Center 8.98 μsec				
.077 μsec					Hi 9.2 μsec				
11. Pulse Fall Time					30. Decoder Reject Limits @ -55 dBm				
.041 μsec					Low 8.673 μsec				
12. Pulse Rf Spectrum @ 6 dB BW					Hi 9.24 μsec				
1.6 MHz					Pulse OK				
13. Reply Delay @ -55 dBm					CW N/A				
2.498 μsec					31. Decoder Immunity @ 0 dBm				
14. Delay Variation vs Signal (dBm)					TRANSPONDER				
Absolute 0.026 μsec					32. Random Triggering				
15. Delay Jitter vs Signal (dBm)					NONE pps				
Absolute 0.052 μsec					33. Recovery Time @ 0 dBm				
0 2.495 -10 2.493 -20 2.501 -30 2.525 -40 2.568 -50 2.57					38 μsec				
Jit .003 .005 .005 .0048 .006 .016					34. Over-Interrogation				
-57 2.572 -60 2.577 -62 2.589 -65 2.643 -67 2.617 -70 2.565					3705 pps				
Jit .018 .021 .025 .034 .038 .055					35. Maximum Duty Cycle				
16. Delay Variation vs Freq. (MHz)					Product 1.0034				
Absolute .004 μsec					36. Operating Current vs Voltage				
17. Delay Jitter vs Freq. (MHz)					Quiet				
Absolute .007 μsec					24 .68 A 26 .68 A 28 .68 A 30 .68 A 32 .68 A				
-1.5 2.498 -12.499 -.5 2.502 +.5 2.50 +1 2.498 +1.5 2.5					Vdc .71 A .71 A .71 A .71 A Integ. .71 A				
Jit .017 .018 .013 .015 .020 .019					37. Pressurization Test				
18. Delay Variation vs PRF (pps)					N/A				
Absolute .016 μsec					Go				
19. Delay Jitter vs PRF (pps)					No Go				
Absolute .009 μsec					COHERENCY				
100 2.521 160 2.59 320 2.589 640 2.52 1000 2.52 1500 2.505					Std Dev.				
Jit .015 .016 .022 .024 .021 .013					Vol Accry				
20. Delay Variation vs Opr. Voltage					Carrier Phase Coherency				
Absolute .003 μsec					Hz				
21. Delay Jitter vs Opr. Voltage					ft/sec				
Absolute .009 μsec					39. Carrier Line Width @ 3 dB				
24 2.513 26 2.511 28 2.51 30 2.51 32 2.511					Hz				
Jit .010 .012 .017 .017 .019					40. Spectral Skew @ ± 350 KHz				
22. Peak Power Output					dB				
Xponder 170 Watts					41. Interline Noise (relative)				
ANT. NO 1					dB				
Watts					42. Dynamic Pulse Spectrum				
ANT. NO 2					Carrier Δ Hz				
Watts					Interline Δ Hz				
ANT. NO 3					43. Frequency Tracking				
Watts					Low - 6 MHz				
TEST PERFORMED BY					Hi + 5 MHz				
DATE					TEST ACCEPTANCE				
3 AUG 87					DATE				
SAMTEC ACCEPTANCE					DATE				

TEST SET P/N TTS	TEST SET S/N 0001	BEACON ON 1100	BEACON OFF 1530	TOTAL TIME 3 Hours	MAG. BURN-IN-DATE N/A	LAST PERFORMED DATE
ANTENNA S/N	ANT. 1 S/N	ANT. 2 S/N	ANT. 3 S/N	COUPLER P/N	COUPLER S/N	BATT. P/N
						BATT. S/N
						DATED

TRANSMITTER		RECEIVER		Total
1. Time to See - Pwr Delay Timer	< 30	Sec	23. Receiver Bandwidth @ 3 dB	11.7
2. Time to Stabilize	180	Sec	Low	5759.5 MHz
3. Transmitter Frequency (+3 min)	Start 5728.2	MHz	Hi	5771.2
(+10 min)	Finish 5728.6	MHz	Total	5771.2
4. Frequency Drift Rate (MHz/min)	Start 1.266	MHz	24. Receiver Bandwidth @ 60 dB	
	Finish 1.133	MHz	Low	
5. Pulse Frequency Jitter		MHz	Center	
6. Pulse Width	0.5 0.982	µsec	Hi	
✓ 0.75 0.1231	µsec	25. Threshold Sensitivity	Low	< -69
0.10 0.983	µsec	26. Dynamic Range	Hi	< -64
7. Pulse Width Jitter	✓ 1.0033	µsec	dBm	0
8. Pulse Amplitude Variation	< 1.0	dB	27. Image Rejection	
9. Pulse Amplitude Jitter	< 0.5	dB	28. Pulse Width Acceptance	Low < 1.5
10. Pulse Rise Time	1.013	µsec	Center	Hi > 3.0
11. Pulse Fall Time	1.020	µsec	29. Decoder Accept Limits @ -55 dBm	Low 8.78
12. Pulse Rf Spectrum @ 6 dB BW	2.2	MHz	Center	Hi 9.2
13. Delay @ -55 dBm	2.508	µsec	30. Decoder Reject Limits @ -55 dBm	Low 8.7
14. Delay Variation vs Signal (dBm)	Absolute 0.042	µsec	Hi 9.25	Pulse
15. Delay Jitter vs Signal (dBm)	Absolute 0.042	µsec	31. Decoder Immunity @ 0 dBm	OK
0 2.513 -10 2.509 -20 2.507 -30 2.501 -40 2.534 -50 2.51			TRANSPONDER	
lit 1.007 1.007 1.010 1.012 0.25 0.25			32. Random Triggering	NONE
-57 2.506 -60 2.514 -62 2.524 -65 2.533 -67 2.542 -70 -			33. Recovery Time @ 0 dBm	38
lit 0.21 0.030 0.029 0.030 0.049 -			34. Over-Interrogation	3285
16. Delay Variation vs Freq. (MHz)	Absolute 0.003	µsec	35. Maximum Duty Cycle	Product
17. Delay Jitter vs Freq. (MHz)	Absolute 0.000	µsec	36. Operating Current vs Voltage	Quiet
-1.52 2.50 -12.502 -15.2502 +15.2505 +12.503			24 68 A 26 68 A 28 68 A 30 68 A 32 68 A	
lit 0.19 0.020 0.020 0.012 0.012 0.015			Vdc	71 A
18. Delay Variation vs PRF (pps)	Absolute 0.014	µsec	37. Pressurization Test	✓ N/A
19. Delay Jitter vs PRF (pps)	Absolute 0.011	µsec	COHERENCY	Std Dev.
100 2.516 160 2.515 320 2.514 640 2.513 1000 2.5 1500 2.502			38. Carrier Phase Coherency	Hz
lit 0.18 0.019 0.022 0.025 0.014 0.014			39. Carrier Line Width @ 3 dB	Hz
20. Delay Variation vs Opr. Voltage	Absolute 0.004	µsec	40. Spectral Skew @ ± 350 KHz	dB
21. Delay Jitter vs Opr. Voltage	Absolute 0.004	µsec	41. Interline Noise (relative)	dB
24 2.504 26 2.507 28 2.502 30 2.523 32 2.503			42. Dynamic Pulse Spectrum	Carrier Δ Hz
lit 0.015 0.016 0.014 0.012 0.012			43. Frequency Tracking	Low
22. Peak Power Output	105	Watts	Hi	
ANT. NO 1	ANT. NO 2	ANT. NO 3		
Watts	Watts	Watts		
TEST PERFORMED BY	DATE	TEST ACCEPTANCE	QA	DATE
Samuel F	8 Nov 76			
SAMTEC ACCEPTANCE		DATE		

102-C 3150		31801		WAFER S/N		TEST DOCUMENT		CODE NAME		R/U	
TEST SET P/N		TEST SET S/N		BEACON		BEACON		TOTAL TIME		MAG. BURN-IN-DATE LAST PERFORMED	
TTS		0001		ON		OFF		5 Hours		DATE	
ANTENNAS P/N		ANT. 1 S/N		ANT. 2 S/N		ANT. 3 S/N		COUPLER P/N		COUPLER S/N	
TRANSMITTER				RECEIVER				Total			
1. Time to See - Pwr Delay Timer		< 30 Sec		23. Receiver Bandwidth @ 3 dB				11.1 MHz			
2. Time to Stabilize		180 Sec		Low		5483.1 MHz		5494.2 MHz			
3. Transmitter Frequency (+3 min)		Start 5698.2 MHz		24. Receiver Bandwidth @ 60 dB							
(+10 min)		Finish 5698.2 MHz		Low							
4. Frequency Drift Rate (MHz/min)		Start 0.333 MHz		Center							
		Finish 0 MHz		MHz		MHz					
5. Pulse Frequency Jitter		N/A MHz		25. Threshold Sensitivity				-68 dBm			
6. Pulse Width		0.534 μsec		26. Dynamic Range		Low		-63 dBm		0 dBm	
		0.535 μsec									
		0.535 μsec									
7. Pulse Width Jitter		.004 μsec		27. Image Rejection							
8. Pulse Amplitude Variation		< 1.0 dB		28. Pulse Width Acceptance		Low		< .2 μsec		> 3 μsec	
9. Pulse Amplitude Jitter		< 0.5 dB		29. Decoder Accept Limits @ -55 dBm		Low		4.76 μsec		4.98 μsec	
10. Pulse Rise Time		.011 μsec				Center		5.2 μsec			
11. Pulse Fall Time		.025 μsec		30. Decoder Reject Limits @ -55 dBm		Low		4.7 μsec		5.21 μsec	
12. Pulse Rf Spectrum @ 6 dB BW		2.2 MHz		31. Decoder Immunity @ 0 dBm		Pulse		OK		N/A	
13. Reply Delay @ -55 dBm		2.48 μsec		TRANSPONDER				NONE		pps	
14. Delay Variation vs Signal (dBm)		Absolute 0.19 μsec		32. Random Triggering				45		μsec	
15. Delay Jitter vs Signal (dBm)		Absolute 0.135 μsec		33. Recovery Time @ 0 dBm				2920		pps	
0 2.49 -10 2.49 -20 2.49 -30 2.50 -40 2.49 -50 2.48				34. Over-Interrogation				Product .0015			
Jit .005 .005 .005 .004 .038 .007				35. Maximum Duty Cycle							
-57 2.48 -60 2.50 -62 2.52 -65 2.52 -67 2.67 -70 -				36. Operating Current vs Voltage		24 .7 A 26 .7 A 28 .7 A 30 .7 A 32 .7 A		Quiet			
Jit .010 .012 .027 .045 .139 -				Vdc .85 A .85 A .85 A .85 A .85 A				Inter			
16. Delay Variation vs Freq. (MHz)		Absolute 0.01 μsec		37. Pressurization Test		<input checked="" type="checkbox"/> N/A		<input type="checkbox"/> Go		<input type="checkbox"/> No Go	
17. Delay Jitter vs Freq. (MHz)		Absolute 0.006 μsec		COHERENCY				Std Dev.		Vel Accy	
-1.5 2.47 -1.2 2.47 -1.5 2.47 +1.5 2.48 +1.2 2.48 +1.5 2.47				38. Carrier Phase Coherency				Hz		ft/sec	
Jit .008 .008 .006 .007 .008 .012				39. Carrier Line Width @ 3 dB							
18. Delay Variation vs PRF (pps)		Absolute 0.03 μsec		40. Spectral Skew @ 1360 KHz							
19. Delay Jitter vs PRF (pps)		Absolute 0.00 μsec		41. Interline Noise (relative)							
100 2.47 160 2.47 320 2.47 640 2.47 1000 2.48 1500 2.50				42. Dynamic Pulse Spectrum		Carrier		Interline			
Jit .008 .008 .008 .008 .008 .008						dB		dB			
20. Delay Variation vs Opr. Voltage		Absolute 0.0 μsec		43. Frequency Tracking		Low		MHz		MHz	
21. Delay Jitter vs Opr. Voltage		Absolute 0.001 μsec									
24 2.48 26 2.48 28 2.48 30 2.48 32 2.48											
Jit .007 .008 .008 .008 .008											
22. Peak Power Output		530 Watts									
ANT. NO 1		ANT. NO 2		ANT. NO 3							
Watts		Watts		Watts							
TEST PERFORMED BY		DATE		TEST ACCEPTANCE		QA		DATE		SAMTEC ACCEPTANCE	
SMITH IF		4 Oct 76									

VEGA 3022 3150		4STD KFMIL		3100110	
VEHICLE TYPE		FACILITY		WAFER S/N	
TEST SET P/N		TEST SET S/N		BEACON	
ANTENNAS P/N		ANT. 1 S/N		ANT. 2 S/N	
TRANSMITTER		RECEIVER		Total	
1. Time to See - Pwr Delay Timer		23. Receiver Bandwidth @ 3 dB		12.92 MHz	
2. Time to Stabilize		Low		5699.6 MHz	
3. Transmitter Frequency (+3 min)		24. Receiver Bandwidth @ 60 dB		Total	
4. Frequency Drift Rate (MHz/min)		Low		Center	
5. Pulse Frequency Jitter		25. Threshold Sensitivity		-69 dBm	
6. Pulse Width		26. Dynamic Range		-64 dBm 0 dBm	
7. Pulse Width Jitter		27. Image Rejection		dB	
8. Pulse Amplitude Variation		28. Pulse Width Acceptance		Low	
9. Pulse Amplitude Jitter		29. Decoder Accept Limits @ -55 dBm		Low	
10. Pulse Rise Time		30. Decoder Reject Limits @ -55 dBm		Low	
11. Pulse Fall Time		31. Decoder Immunity @ 0 dBm		Pulse	
12. Pulse Rf Spectrum @ 6 dB BW		TRANSPONDER		NONE	
13. Reply Delay @ -55 dBm		32. Random Triggering		pps	
14. Delay Variation vs Signal (dBm)		33. Recovery Time @ 0 dBm		42 μsec	
15. Delay Jitter vs Signal (dBm)		34. Over-Interrogation		3155 pps	
16. Delay Variation vs Freq. (MHz)		35. Maximum Duty Cycle		Product	
17. Delay Jitter vs Freq. (MHz)		36. Operating Current vs Voltage		Quiet	
18. Delay Variation vs PRF (pps)		37. Pressurization Test		Go No Go	
19. Delay Jitter vs PRF (pps)		COHERENCY		Std Dev.	
20. Delay Variation vs Opr. Voltage		38. Carrier Phase Coherency		Hz	
21. Delay Jitter vs Opr. Voltage		39. Carrier Line Width @ 3 dB		Hz	
22. Peak Power Output		40. Spectral Skew @ ± 350 KHz		dB	
ANT. NO 1		41. Interline Noise (relative)		dB	
ANT. NO 2		42. Dynamic Pulse Spectrum		Carrier	
ANT. NO 3		43. Frequency Tracking		Low	
TEST PERFORMED BY		DATE		TEST ACCEPTANCE	
DATE		DATE		SAMTEC ACCEPTANCE	



Radex Radio Co. - - - System
AM/FM - - - Ser. #
B1514 - - - 1948

D

Delay in lead edge of pulse with respect to sweep start (if any)

_____ nano sec

Switch selected (one only)	Measured Width	Nominal Width (nano sec)	Δ
5-3	<u>1651</u>	1525	- 1
5-4	<u>892</u>	763	+ 3
5-5	<u>511</u>	381	+ 4
5-6	<u>319</u>	191	+ 2
5-7	<u>222</u>	95	+ 1
5-8	<u>173</u>	48	- 1
5-9	<u>144</u>	24	- 6
5-10	<u>136</u>	12	- 2
None	<u>126</u>		<u>- 2</u>
			<u>0 53.2</u>

Switch Combinations	Measured Width	Nominal Width μ sec
4,6,8 4,7,10	<u>.999</u>	1.0
5 through 10 5,6,8	<u>.749</u>	.75
6,7,9 6,7,8,9,10	<u>.497</u>	.5
6,8,10 7,9	<u>.247</u>	.25

C

RCM Range Position (yds)

Console Range (yds)

100K

100,000 -1

200K

200,000 -1

300K

300,000 -1

400K

400,000 -1

500K

500,000 -1

600K

600,000 -1

700K

700,000 -1

800K

800,000 -1

1000K

1,000,000 -1

50K

50,000 -1

25K

25,000 -1

A

B12 and B14 switch positions after initial calibration

B12 Position 2 3 + 4 on

B14 Position

1 5 6 7 8 off

B

Attenuation (db)	Console Range (yds)	Nominal(yds)	AGC Volts
0	<u>100,001</u>	100K	<u>6</u>
5	<u>100,001</u> -3	100K	<u>5.7</u>
10	<u>100,003</u> -1	100K	<u>5.3</u>
15	<u>100,001</u> -3	100K	<u>4.95</u>
20	<u>100,001</u> -3	100K	<u>4.6</u>
25	<u>100,001</u>	100K	<u>4.4</u>
30	<u>100,001</u>	100K	<u>4.2</u>
35	<u>100,001</u>	100K	<u>4.2</u>
40	<u>100,001</u>	100K	<u>4.2</u>
45	<u>100,001</u>	100K	<u>4.2</u>
50	<u>100,001</u>	100K	<u>4.1</u>

Corrections Applied to Radar Beacon Lock On Data

Corrections for 174 beacon

+11 yds for beacon delay error (used 2.573 instead of 2.503)
-2.3 yds for pulse width calibrated for .927 instead of .955
-4 yds for cable delay (between beacon and antenna)
+4.7 yds Correction (Total)
+8040.8 yds Measured with radar
8045.5 yds Corrected

Correction for 302 beacon

+13 yds for beacon delay error (used 2.56 instead of 2.48)
0 yds for pulse width
-4 yds for cable delay
+9 yds Correction (Total)
8045.4 Measured with radar
8054.4 yds Corrected